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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR		ATTORNEY DOCKET NO.
09/418,818	10/15/99	CHEUNG	D	AM1084D01/T9

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EXAMINER	
ZERVIGON, R	
ART UNIT	PAPER NUMBER
1763	6

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Please find below and/or attached an Office communication concerning this application or proceeding.

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Office Action Summary	Application No. 09/418,818	Applicant(s) CHEUNG et al
	Examiner Rudy Zervigon	Art Unit 1763

-- The MAILING DATE of this communication appears on the cover sheet with the correspondenc address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on *Apr 16, 2000*

2a) ☐ This action is **FINAL.** 2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle* 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) *1-10 and 44-62* is/are pending in the applica

4a) Of the above, claim(s) ______ is/are withdrawn from considera

5) ☐ Claim(s) ______ is/are allowed.

6) ☒ Claim(s) *1-10 and 44-62* is/are rejected.

7) ☐ Claim(s) ______ is/are objected to.

8) ☐ Claims ______ are subject to restriction and/or election requirem

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☒ The drawing(s) filed on *Oct 15, 1999* is/are objected to by the Examiner.

11) ☐ The proposed drawing correction filed on ______ is: a) ☐ approved b) ☐ disapproved.

12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

a) ☐ All b) ☐ Some* c) ☐ None of:

1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ______.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

*See the attached detailed Office action for a list of the certified copies not received.

14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

15) ☒ Notice of References Cited (PTO-892)

16) ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948)

17) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s). *4*

18) ☐ Interview Summary (PTO-413) Paper No(s). ______

19) ☐ Notice of Informal Patent Application (PTO-152)

20) ☐ Other:

DETAILED ACTION

Drawings

1. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, "a power supply *coupled* between the substrate supporter and the gas manifold" must be shown or the feature canceled from the claim. No new matter should be entered.

Double Patenting

2. A rejection based on double patenting of the "same invention" type finds its support in the language of 35 U.S.C. 101 which states that "whoever invents or discovers any new and useful process ... may obtain a patent therefor ..." (Emphasis added). Thus, the term "same invention," in this context, means an invention drawn to identical subject matter. See *Miller v. Eagle Mfg. Co.*, 151 U.S. 186 (1894); *In re Ockert*, 245 F.2d 467, 114 USPQ 330 (CCPA 1957); and *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970).

A statutory type (35 U.S.C. 101) double patenting rejection can be overcome by canceling or amending the conflicting claims so they are no longer coextensive in scope. The filing of a terminal disclaimer cannot overcome a double patenting rejection based upon 35 U.S.C. 101.

Claims 60 and 61 are rejected under 35 U.S.C. 101 as claiming the same invention as that of claims 1-37 of prior U.S. Patent No. 5,968,324. This is a double patenting rejection.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claims 1-10 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Claim 1 requires "a power supply *coupled* between the substrate supporter and the gas manifold" however the specification does not teach one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention with this stated relationship.

5. Claim 3 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The requirement of a gas distribution system "to introduce a second process gas comprising He (col.5,lines 13-20, 42) into the chamber controls the chamber pressure at about 1 to 6 torr." is not clear because this can be interprited as a "chamber pressure" of He rendering it a <u>partial pressure</u> or a "chamber pressure" as overall pressure or <u>total pressure</u>.

6. Claim 3 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The requirement of "...controls the introduction of the SiH_4 to be a ratio of between 0.5 to 3 times the amount of N_2O." is unclear because a multiplication ("times") in a discussion of "ratio"

inaccurately claims the disclosed invention (page 6, lines 28-29). It is unclear wether the ratio discussed is a volumetric or mass ratio.

7. Claim 51 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The unit "mils" is not an accepted S.I. standard for a distance. It will be interprited as milimeters (mm) in the claim rejections.

8. Claims 44-52 recite the limitation "vacuum chamber" in claim 44. There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 102

9. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless --
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

10. Claims 44 and 45 are rejected under 35 U.S.C. 102(b) as being anticipated by Felts et al (U.S.Pat. 4,888,199). Felts et al (U.S.Pat. 4,888,199) teaches:

i. 44. A substrate processing system, comprising:

ii. a process chamber (item 11, Figure 1;col.4,lines 8-31 - both Felts et al);

iii. a substrate support (item 53, Figure 2;col.4,lines 48-60), located within the vacuum chamber (item 11, Figure 1;col.4,lines 8-31 - both Felts et al), for supporting a substrate (item 13, Figure 1,2)

iv. a power supply (item 17, Figure 1,2;col.3,line 61-65)

v. a gas delivery system (item 15, Figure 1,2;col.3,lines 59--61) for delivering process gases (col.5,lines 3-40) into the process chamber (item 11, Figure 1;col.4,lines 8-31 - both Felts et al);

vi. a controller (item 27, Fig.1;col.5,line 27 through the end of the patent) configured to control the power supply (item 17, Figure 1,2;col.3,line 61-65,Both Felts et al) and the gas delivery system (item 15, Figure 1,2;col.3,lines 59--61);

vii. a memory (column 10, lines 56-64) coupled to the controller (item 27, Fig.1;col.5,line 27 through the end of the patent) comprising a computer readable program (column 16 - column 46- Felts et al 4,888,199) having a computer readable program (column 16 - column 46- Felts et al 4,888,199) embodied therein for directing operation of the substrate (item 13, Figure 1,2) processing system , the computer readable program (column 16 - column 46- Felts et al 4,888,199) including a first (column 5, lines 16-40) (column 5, lines 16-40) set of computer instructions (column 16 -column 46 - Felts et al- 199) for controlling the gas delivery system (item 15, Figure 1,2;col.3,lines 59--61) to introduce selected deposition gases (column 5, lines 17-40) into the process chamber (item 11, Figure 1;col.4,lines 8-31 - both Felts et al) at deposited gas flow rates,

viii. a second (column 10, lines 47-50; col.31 - Felts et al 4,888,199) set of computer instructions (column 16 -column 46 - Felts et al- 199) for controlling the gas delivery system (item 15, Figure 1,2;col.3,lines 59--61) to add a flow of an inert gas ("He",column 10, lines 47-50; col.31) to the selected deposition gases (column 5, lines 17-40) at a flow rate previously determined to achieve a desired low deposition rate from a plasma (column 5, lines 17-40) enhanced reaction of the selected deposition gases (column 5, lines 17-40), the desired low deposition rate being lower than a deposition rate using the selected deposition gases (column 5, lines 17-40) at the deposition gas flow rates with a lower flow rate of the inert gas ("He",column 10, lines 47-50; col.31), and a third set of computer instructions (column 16 -column 46 - Felts et al- 199) for controlling the power supply (item 17, Figure 1,2;col.3,line

61-65,Both Felts et al) to supply power to the process chamber (item 11, Figure 1;col.4,lines 8-31 - both Felts et al) to produce a plasma (column 5, lines 17-40) enhanced reaction of the deposition gases (column 5, lines 17-40) in the process chamber (item 11, Figure 1;col.4,lines 8-31 - both Felts et al) to deposit a film at the low deposition rate.

Felts et al (U.S.Pat. 4,888,199) anticipates the claimed relationship of deposition rates and the presence of an inert gas with added appreciation to the Felts et al (U.S.Pat. 4,888,199) dicussion:

Claimed:

$$D_{-IG} > D_{+IG}$$

Where D represents "deposition rate", "-/+" represents without (-) or with (+) inert gas (IG). With the addition of an IG (He) the partial pressures of all "selected deposition gases" will deminish and effectively "lower" or reduce the deposition rate. In addition, as discussed by Felts et al (U.S.Pat. 4,888,199), the addition of He increases electron density in the plasma (column 10, lines 47-50) which anticipates the effect of reduced deposition rates considering the fact that these added electrons would effectively shield cations thereby reducing one of the chemical mechanisms of PECVD.

11. Claims 60 and 61 are rejected under 35 U.S.C. 102(e) as being clearly anticipated by David Cheung et al (U.S.Pat. 5,968,324). David Cheung et al (U.S.Pat. 5,968,324) teaches:

ix. 60. A substrate processing system comprising:

x. means for forming an antireflective layer over a layer on a substrate by flowing selected deposition gases into a substrate processing chamber at deposition gas flow rates and

adding a flow of an inert gas to the selected deposition gases to deposit the antireflective layer at a desired deposition rate which is lower than a deposition rate using the selected deposition gases at the deposition gas flow rates with a lower flow rate of the inert gas ;

xi. means for forming a layer of photoresist on the antireflective layer, the antireflective layer having a thickness and refractive indices such that a first reflection from an interface between the photoresist and the antireflective layer of an exposure light will be an odd number which is at least 3 multiplied by 180° out of phase with a second reflection from an interface between the antireflective layer and the substrate layer of the exposure light; and

means for forming a photoresist pattern by exposing the photoresist layer to the exposure light and developing the exposed photoresist layer.

61. A substrate processing system comprising:

xii. means for forming an SiON antireflective layer over a first layer on a substrate by flowing selected deposition gases into a substrate processing chamber at deposition gas flow rates and adding a flow of an inert gas to the selected deposition gases to deposit the SiON antireflective layer at a desired deposition rate which is lower than a deposition rate using the selected deposition gases at the deposition gas flow rates with a lower flow rate of the inert gas , said antireflective layer having a refractive index in the range of 1.7-2.9, an <u>absorptive index</u> in the range of 0-1.3, and a thickness in the range of 200-3000 angstroms

xiii. Means for forming a layer of photoresist over the antireflective layer; and

xiv. means for forming a photoresist pattern by exposing the photoresist layer to an exposure light having a wavelength of 365 nm or less and developing the exposed photoresist layer, wherein a phase shift of an odd multiple of at least 3 multiplied by 180° exists between a first reflection of the exposure light from an interface between the photoresist layer and the antireflective layer and a second reflection of the exposure light from an interface between the antireflective layer and the first layer, the first reflection having almost the same intensity as the second reflection to thereby substantially cancel the first and second reflections.

12. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless --
>
> (g) before the applicant's invention thereof the invention was made in this country by another who had not abandoned, suppressed, or concealed it. In determining priority of invention there shall be considered not only the respective dates of conception and reduction to practice of the invention, but also the reasonable diligence of one who was first to conceive and last to reduce to practice, from a time prior to conception by the other.

13. Claims 60 and 61 are rejected under 35 U.S.C. 102(g) as being clearly anticipated by David Cheung et al (U.S.Pat. 5,968,324). David Cheung et al (U.S.Pat. 5,968,324) teaches:

xv. 60. A substrate processing system comprising:

xvi. means for forming an antireflective layer over a layer on a substrate by flowing selected deposition gases into a substrate processing chamber at deposition gas flow rates and adding a flow of an inert gas to the selected deposition gases to deposit the antireflective layer at a desired deposition rate which is lower than a deposition rate using the selected deposition gases at the deposition gas flow rates with a lower flow rate of the inert gas ;

xvii. means for forming a layer of photoresist on the antireflective layer, the antireflective layer having a thickness and refractive indices such that a first reflection from an interface between the photoresist and the antireflective layer of an exposure light will be an odd number which is at least 3 multiplied by 180° out of phase with a second reflection from an interface between the antireflective layer and the substrate layer of the exposure light; and

means for forming a photoresist pattern by exposing the photoresist layer to the exposure light and developing the exposed photoresist layer.

61. A substrate processing system comprising:

xviii. means for forming an SiON antireflective layer over a first layer on a substrate by flowing selected deposition gases into a substrate processing chamber at deposition gas flow rates and adding a flow of an inert gas to the selected deposition gases to deposit the SiON antireflective layer at a desired deposition rate which is lower than a deposition rate using the selected deposition gases at the deposition gas flow rates with a lower flow rate of the inert gas , said antireflective layer having a refractive index in the range of 1.7-2.9, an absorptive index in the range of 0-1.3, and a thickness in the range of 200-3000 angstroms

xix. Means for forming a layer of photoresist over the antireflective layer; and

xx. means for forming a photoresist pattern by exposing the photoresist layer to an exposure light having a wavelength of 365 nm or less and developing the exposed photoresist layer, wherein a phase shift of an odd multiple of at least 3 multiplied by 180° exists between a first reflection of the exposure light from an interface between the photoresist layer and the

antireflective layer and a second reflection of the exposure light from an interface between the antireflective layer and the first layer, the first reflection having almost the same intensity as the second reflection to thereby substantially cancel the first and second reflections.

Claim Rejections - 35 USC § 103

14. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

15. Claims 1 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Felts et al (U.S.Pat. 5,365,665). Felts et al (U.S.Pat. 5,365,665) describes:

1. A substrate (item13;Fig.2;col.5,lines50-64) processing system (item 10, Figure1;col.5,lines51-64), comprising:

xxi. a vacuum chamber (item 11, Figure1;col.5,lines51-64); a substrate (item13;Fig.2;col.5,lines50-64) supporter (item32,42a,b;Fig.2;col.6,lines49-66), located within the vacuum chamber (item 11, Figure1;col.5,lines51-64), for holding a substrate (item13;Fig.2;col.5,lines50-64)

xxii. a gas manifold (item15;Fig.1;col.6,line31) for introducing process gases (col.5, lines 10-20,32-43) into the chamber

xxiii. a gas distribution system ("Flow Controller (item 27; col.6,lines13-20)";Fig.2;col.6), coupled to the gas manifold (item15;Fig.1;col.6,line31), for distributing the process gases (col.5, lines 10-20,32-43) to the gas manifold (item15;Fig.1;col.6,line31) from gas sources;

xxiv. a power supply (item 17, Fig.1,2;col.5, line 65-20,32-col.6,line 5) coupled between the substrate (item13;Fig.2;col.5,lines50-64) supporter (item32,42a,b;Fig.2;col.6,lines49-66) and the gas manifold (item15;Fig.1;col.6,line31)

xxv. a vacuum system (item 19, Fig.1,2; col.6,lines1-5) for controlling pressure (col.6,lines1-5) within the vacuum chamber (item 11, Figure1;col.5,lines51-64)

xxvi. a controller (item 27; col.6,lines13-20), including a computer (col.6, lines 13-20), for controlling the gas distribution system ("Flow Controller (item 27; col.6,lines13-20)";Fig.2;col.6), the power supply (item 17, Fig.1,2;col.5, line 65-20,32-col.6,line 5) and the vacuum system (item 19, Fig.1,2; col.6,lines1-5)

xxvii. a memory ("including a computer controlled portion..and send controlling commands to them (col.6, lines 13-20)") coupled to the controller (item 27; col.6,lines13-20) comprising a computer (col.6, lines 13-20) readable medium having a computer (col.6, lines 13-20) readable program code (implicit, col.6, lines 13-20) embodied therein for directing operation of the substrate (item13;Fig.2;col.5,lines50-64) processing system (item 10, Figure1;col.5,lines51-64), the computer (col.6, lines 13-20) readable program code (implicit, col.6, lines 13-20) including:

xxviii. computer (col.6, lines 13-20) readable program code (implicit, col.6, lines 13-20) for causing the gas distribution system ("Flow Controller (item 27; col.6,lines13-20)";Fig.2;col.6) to introduce a first process gas comprising a mixture of organosilanes $-SiH_3$ (col.1,line20; organosilanes containing $-SiH_3$ - col.5, lines1-6) and N_2O (col5,lines 37-42;col.1,line 21) into

the chamber to deposit a first plasma enhanced CVD (col.1,lines10-14) layer over the wafer (Fig.2,item 13)

xxix. A computer (col.6, lines 13-20) readable program code (implicit, col.6, lines 13-20) for causing the gas distribution system ("Flow Controller (item 27; col.6,lines13-20)";Fig.2;col.6) to introduce a second process gas comprising He (col.5,lines 13-20, 42) into the chamber to control the deposition rate of the first layer

xxx. 7. A substrate (item13;Fig.2;col.5,lines50-64) processing system (item 10, Figure1;col.5,lines51-64) as in claim 1 further comprising computer (col.6, lines 13-20) readable program code (implicit, col.6, lines 13-20) for controlling the gas distribution system ("Flow Controller (item 27; col.6,lines13-20)";Fig.2;col.6) to operate for a specified time period ()

Felts et al (U.S.Pat. 5,365,665) does not precisely describe a first process gas comprising a mixture SiH_4, however Felts et al (U.S.Pat. 5,365,665) does teach its use as an alternative (col. 1,line 20). It would have been obvious to one of ordinary skill in the art at the time the invention was made to introduce a first process gas comprising a mixture of SiH_4 and N_2O (col5,lines 37-42;col.1,line 21) into the chamber to deposit a first plasma enhanced CVD (col.1,lines10-14) layer over the wafer (Fig.2,item 13).

Motivation for introducing a first process gas comprising a mixture of SiH_4 and N_2O (col5,lines 37-42;col.1,line 21) into the chamber to deposit a first plasma enhanced CVD (col.1,lines10-14) layer

over the wafer (Fig.2,item 13) is drawn from the very teachings of Felts et al (U.S.Pat. 5,365,665) wich discuss the use of silane gas as precursor for films (col. 1,lines 10-20).

16. Claims 2-6, 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Felts et al (U.S.Pat. 5,365,665), as applied to claim 1 above, and further in view of Thomas S. Dory (U.S. Pat, 4,877,641). Felts et al (U.S.Pat. 5,365,665) teaches:

xxxi. 2. A substrate (item13;Fig.2;col.5,lines50-64) processing system (item 10, Figure1;col.5,lines51-64) as in claim 1 wherein the computer (col.6, lines 13-20) readable program code (implicit, col.6, lines 13-20) for causing the gas distribution system ("Flow Controller (item 27; col.6,lines13-20)";Fig.2;col.6) to introduce the first process gas comprising a mixture of SiH_4 (col.1,line20; organosilanes containing SiH_4 - col.5, lines1-6) and N_2O (col5,lines 37-42;col.1,line 21) into the chamber controls the introduction of the SiH_4 (col.1,line20; organosilanes containing SiH_4 - col.5, lines1-6) to be between 500 to 1000 sccm, and the rate of N_2O (col5,lines 37-42;col.1,line 21) to be undisclosed.

xxxii. 3. A substrate (item13;Fig.2;col.5,lines50-64) processing system (item 10, Figure1;col.5,lines51-64) as in claim 2 wherein the computer (col.6, lines 13-20) readable program code (implicit, col.6, lines 13-20) for causing the gas distribution system ("Flow Controller (item 27; col.6,lines13-20)";Fig.2;col.6) to introduce a second process gas comprising He (col.5,lines 13-20, 42) into the chamber controls the (total) <u>chamber pressure at about < 0.1 torr (column 6,line 4)</u>

xxxiii. 5. A substrate (item13;Fig.2;col.5,lines50-64) processing system (item 10, Figure1;col.5,lines51-64) as in claim 1 further comprising:

xxxiv. computer (col.6, lines 13-20) readable program code (implicit, col.6, lines 13-20) for causing the gas distribution system ("Flow Controller (item 27; col.6,lines13-20)";Fig.2;col.6) to introduce a fourth process gas comprising N_2 (col.5,lines 32-42) into the chamber (column 3,lines 30-50)

Felts et al (U.S.Pat. 5,365,665) does not teach

xxxv. 2. the computer (col.6, lines 13-20) readable program code (implicit, col.6, lines 13-20) for causing the gas distribution system ("Flow Controller (item 27; col.6,lines13-20)";Fig.2;col.6) to introduce the first process gas comprising a mixture of SiH_4 (col.1,line20; organosilanes containing SiH_4 - col.5, lines1-6) and N_2O (col5,lines 37-42;col.1,line 21) into the chamber controls the introduction of the SiH_4 (col.1,line20; organosilanes containing SiH_4 - col.5, lines1-6) <u>to be between 5 to 300 sccm</u>, and the rate of N_2O (col5,lines 37-42;col.1,line 21) <u>to be between 5 to 300 sccm</u>.

xxxvi. 3. A substrate (item13;Fig.2;col.5,lines50-64) processing system (item 10, Figure1;col.5,lines51-64) as in claim 2 wherein the computer (col.6, lines 13-20) readable program code (implicit, col.6, lines 13-20) for causing the gas distribution system ("Flow Controller (item 27; col.6,lines13-20)";Fig.2;col.6) to introduce a second process gas comprising He (col.5,lines 13-20, 42) into the chamber controls the (total) <u>chamber pressure at about 1 to 6 torr</u>

xxxvii. 4. A substrate (item13;Fig.2;col.5,lines50-64) processing system (item 10, Figure1;col.5,lines51-64) as in claim 3 wherein the computer (col.6, lines 13-20) readable program code (implicit, col.6, lines 13-20) for causing the gas distribution system ("Flow Controller (item 27; col.6,lines13-20)";Fig.2;col.6) to introduce the first process gas comprising a mixture of SiH_4 (col.1,line20; organosilanes containing SiH_4 - col.5, lines1-6) and N_2O (col5,lines 37-42;col.1,line 21) into the chamber controls the introduction of the SiH_4 (col.1,line20; organosilanes containing SiH_4 - col.5, lines1-6) <u>to be at a ratio of between 0.5 to 3 times the amount of N_2O</u> (col5,lines 37-42;col.1,line 21).

xxxviii. 5. A substrate (item13;Fig.2;col.5,lines50-64) processing system (item 10, Figure1;col.5,lines51-64) as in claim 1 further comprising:

xxxix. computer (col.6, lines 13-20) readable program code (implicit, col.6, lines 13-20) for causing the gas distribution system ("Flow controller (item 27; col.6,lines13-20)";Fig.2;col.6) to introduce a third process gas comprising NH_3 (col.1,lines 20-23) into the chamber;

xl. 6. A substrate (item13;Fig.2;col.5,lines50-64) processing system (item 10, Figure1;col.5,lines51-64) as in claim 5 wherein:

xli. the computer (col.6, lines 13-20) readable program code (implicit, col.6, lines 13-20) for causing the gas distribution system ("Flow Controller (item 27; col.6,lines13-20)";Fig.2;col.6) to introduce a third process gas comprising NH_3 into the chamber controls the introduction of the NH_3 to be between a rate of 0 to 300 sccm; and

xlii. the computer (col.6, lines 13-20) readable program code (implicit, col.6, lines 13-20) for causing the gas distribution system ("Flow Controller (item 27; col.6,lines13-20)";Fig.2;col.6) to introduce a fourth process gas ("gas or gases" - col.3,line 35) comprising N_2 into the chamber controls the introduction of the N_2 to be between a rate of 0 to 4000 sccm (col.3, line 40).

Thomas S. Dory teaches a plasma enhanced CVD process for forming silicon nitride or silicon dioxide films on substrates (column 1; lines 15-61). Specifically, Thomas S. Dory teaches a gas distribution system (column 3, lines 14-30) to introduce the first process gas comprising a mixture of SiH_4 (col.1,lines 27-28), or alternatives (col.1,lines 36-58), and N_2O (col.3,lines31-44) into the chamber controls where the introduction rate of N_2O is between 5 to 300 sccm (col.3,line 41).

Additionally, Thomas S. Dory teaches chamber controls of the (total) chamber pressure at about 1 to 6 torr (col.4,lines 10-11). Thomas S. Dory also teaches the gas distribution system to introduce a fourth process gas comprising N_2 into the chamber (col.3,lines 35-45;col.4,lines 5-6).

Thomas S. Dory also teaches introducing a third process gas ("gas or gases" - col.3,line 35) comprising NH_3 (col.4,lines 3-4) into the chamber where the introduction of the NH_3 (col.3,lines 35-37) to be between a rate of 0 to 300 sccm (col.3, line 40); and the introduction of the N_2 to be between a rate of 0 to 4000 sccm (col.3, line 40).

Thomas S. Dory additionally teaches NH_3 gas introduced into the chamber at a rate of less than 150 sccm (col.3,lines 39-42) and a fourth process gas comprising N_2 introduced into the chamber at a rate of less than 300 sccm (col.3,lines 39-42).

Thomas S. Dory and Felts et al (U.S.Pat. 5,365,665) each do not teach gas flow rates of between 15 to 160sccm for both N_2O gas and SiH_4 gases. Felts et al (U.S.Pat. 5,365,665) each does not teach gas comprising NH_3 introduced into the chamber at a rate of less than 150 sccm and a fourth process gas comprising N_2 introduced into the chamber at a rate of less than 300 sccm (Thomas S. Dory; Col.3;line 41).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to vary the introduction rate of N_2O as being between 5 to 300 sccm (col.3,line 41) as taught by Thomas S. Dory as the preferred introduction rate of N_2O in the Felts et al (U.S.Pat. 5,365,665) substrate processing system.

Motivation for varying the introduction rate of N_2O as being between 5 to 300 sccm (col.3,line 41) in the Felts et al (U.S.Pat. 5,365,665) substrate processing system is drawn from the Thomas S. Dory discussion - "control of film properties, as expressed by the refractive index (N_f)." (Col.3, lines 45-48), and "Thus for a given pressure and DTBS flow rate, increasing or decreasing the NH_3, N_2, N_2O, or NO flow rate changes the Nf of the film." (Column 3,lines 48-51).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to select the preferred chamber controls of the (total) <u>chamber pressure at about 1 to 6 torr (col.4,lines</u>

10-11) as taught by Thomas S. Dory as the preferred preferred chamber controls of the Felts et al (U.S.Pat. 5,365,665) substrate processing system.

Motivation for selecting the preferred chamber controls of the (total) chamber pressure at about 1 to 6 torr (col.4,lines 10-11) as taught by Thomas S. Dory as the preferred preferred chamber controls of the Felts et al (U.S.Pat. 5,365,665) substrate processing system is drawn from the discussion of Thomas S. Dory where "Thus this *control* of the relative flow rates of the reactants and the *pressure* permits precise *control* of the film properties." (Column 4, lines 27-29).

The flow rate range of SiH_4 discussed by Felts et al (U.S.Pat. 5,365,665) (col.1,line20; organosilanes containing SiH_4 - col.5, lines1-6) to be between 500 to 1000 sccm, and flow rate range of N_2O as discussed by Dory as being between 5 to 300 sccm (col.3,line 41) provides for the following range of flow rate ratios:

Thomas S. Dory:

200 - 4000sccm N_2O (col3.line 41)

Felts et al (U.S.Pat. 5,365,665):

500 - 1000sccm silane as alternative (col.5,lines40-41)

$$500/4000 = 1/8 \le \frac{SiH_4}{N_2O} \le 1000/200 = 5$$

xliii. 8. A substrate (item13;Fig.2;col.5,lines50-64) processing system (item 10, Figure1;col.5,lines51-64) as in claim 7 wherein the computer (col.6, lines 13-20) readable program code (implicit, col.6, lines 13-20) for controlling the gas distribution system ("Flow Controller (item 27; col.6,lines13-20)";Fig.2;col.6) to operate for a specified time period comprises computer (col.6, lines 13-20) readable program code (implicit, col.6, lines 13-20) for causing the first plasma enhanced CVD (col.1,lines10-14) layer to be formed to a thickness which is an odd multiple, greater than one, of a wavelength of light to be used in a subsequent process operation on the layer.

17. Claims 46-48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Felts et al (U.S.Pat. 4,888,199) as applied to claims 44 and 45 above, and further in view of Felts et al (U.S.Pat. 5,365,665). Felts et al (U.S.Pat. 4,888,199) teaches selected deposition gases (item 13, Figure 1,2). However, Felts et al (U.S.Pat. 4,888,199) does not teach:

xliv. 46. The substrate (item 13, Figure 1,2) processing system of claim 44 wherein the selected deposition gases (column 5, lines 13-42) comprise silane and an oxygen source.

xlv. 47. The substrate (item 13, Figure 1,2) processing system of claim 44 wherein the selected deposition gases (column 5, lines 17-40) comprise silane and nitrous oxide.

xlvi. 48. The substrate (item 13, Figure 1,2) processing system of claim 44 wherein the selected deposition gases (column 5, lines 17-40) comprise silane and a nitrogen source.

Felts et al (U.S.Pat.5,365,665) teaches:

xlvii. 46. The substrate (item 13, Figure 1,2) processing system of claim 44 wherein the selected deposition gases (column 5, lines 17-40) comprise silane (col.1,lines19-23) and an oxygen source (column 5, lines 17-40)

xlviii. 47. The substrate (item 13, Figure 1,2) processing system of claim 44 wherein the selected deposition gases (column 5, lines 17-40) comprise silane (col.1,lines19-23) and nitrous oxide (column 5, lines 37-40)

xlix. 48. The substrate (item 13, Figure 1,2) processing system of claim 44 wherein the selected deposition gases (column 5, lines 17-40) comprise silane (col.1,lines19-23) and a nitrogen source (column 5, lines 37-40)

It would have been obvious to one of ordinary skill in the art at the time the invention was made to implement the Felts et al (U.S.Pat. 5,365,665) deposition gases as process gases in the Felts et al (U.S.Pat. 4,888,199) invention.

Motivation for implementing the Felts et al (U.S.Pat. 5,365,665) deposition gases as process gases in the Felts et al (U.S.Pat. 4,888,199) invention is drawn from the desired film for deposition (column 5,lines 43-50) and the effect on the deposition rate (column 5,lines 32-40) and hardness (column 4, lines 47-50).

18. Claims 49-52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Felts et al (U.S.Pat. 4,888,199) as applied to claims 46-48 above, and further in view of Felts et al (U.S.Pat. 5,364,665) and Thomas S. Dory (U.S. Pat, 4,877,641).

Felts et al (U.S.Pat. 4,888,199) describes:

I. 50. A substrate processing system of claim 49 further comprising a heater (col.14,line 61-col.15,line 7) for heating the substrate, and wherein the computer-readable program (column 16 - column 46- Felts et al 4,888,199) further comprises a fifth set of computer instructions for controlling the heater to heat the substrate. Felts et al (U.S.Pat. 4,888,199) teaches "**...240** adapted to maintain heated layer **234** at a temperature above the boiling point of the liquid ... with a boiling point of 55.5°C, and ... with a boiling point of 127°C" (col.14,line 61-col.15,line 7)

Felts et al (U.S.Pat.5,364,665) teaches selected deposition gases (column 5, lines 17-40). Additionally, Felts et al (U.S.Pat.5,364,665) teaches:

Ii. 49. The substrate (item 13, Figure 1,2) processing system of claim 44 further comprising a vacuum system (19,all Figures) for controlling pressure within the process chamber (item 11, Figure 1;col.4,lines 8-31 - both Felts et al), and a computer-readable program (column 6,lines 13-20)

Iii. 51. The substrate (item 13, Figure 1,2) processing system of claim 50 wherein the substrate (item 13, Figure 1,2) support (item 53, Figure 2;col.4,lines 48-60) is spaced "Δ" (column 6,line 62-col.7,line 10) from the gas distribution system at a distance in the range of 200-600 mils, where "mils" is interpritted as millimeters (mm) - "Distance Δ should be no greater than about 12 inches..." or - Δ < 12" = 30.48cm = 304.8mm

Thomas S. Dory teaches:

liii. 49. controlling the vacuum system to maintain a chamber pressure in the range of 1-6Torr (col.4,lines 10-11- Dory 4,877,641), and wherein the selected deposition gases (column 3, lines 31-59) comprise silicon depositing gasses (column 1, lines 27-58;col.3,lines31-33) flowed into the chamber at a rate of 5-300 sccm (col.3;lines31-33) and N_2O flowed into the chamber at a rate of 5-300 sccm (col.3;line41)

liv. 50. A substrate processing system of claim 49 further comprising a heater (col.2,line68-col.3,line 3) for heating the substrate, and controlling the heater to heat the substrate to a temperature in the range of 200-400°C (column 3, lines 4-13-Thomas S. Dory 4,877,641).

lv. 52. A substrate processing system of claim 49 wherein the selected deposition gases (column 1, lines 36-60) further comprise NH_3 (col3,lines 40-41) flowed into the chamber at a rate of less than 300 sccm (Thomas S. Dory; Col.3;lines 31-33), and N_2 flowed into the chamber at a rate of less than 4000 sccm (col.3, line 40 - Dory)

It would have been obvious to one of ordinary skill in the art at the time the invention was made to implement the temperture control computer-readable program (column 6,lines 13-20) as discussed by Felts et al (U.S.Pat.5,364,665) and Felts et al (U.S.Pat. 4,888,199) who describe computer-readable program (column 16 - column 46- Felts et al 4,888,199) comprising a set of computer instructions for controlling the heater to heat the substrate as part of the Dory et al PECVD processing techniques (col.1,lines 23-61).

Motivation for implementing the temperture control computer-readable program (column 6,lines 13-20), as discussed by Felts et al (U.S.Pat.5,364,665), and Felts et al (U.S.Pat. 4,888,199) is directed to Dory et al PECVD processing techniques centering on "isothermal" processing (col.3,lines 4-13).

19. Claims 53-59 are rejected under 35 U.S.C. 103(a) as being unpatentable over Felts et al (U.S.Pat. 5,364,665), as applied to claim 49 in view of Felts et al (U.S.Pat. 4,888,199) and Thomas S. Dory (U.S. Pat, 4,877,641). Felts et al (U.S.Pat. 5,364,665, and 4,888,199) teach:

53. (Amended) A substrate (item 13, Figure 1,2) processing system , comprising:

lvi. a process chamber (item 11, Figure 1;col.4,lines 8-31 - both Felts et al);

lvii. a substrate (item 13, Figure 1,2) support (item 53, Figure 2;col.4,lines 48-60), located within the process chamber (item 11, Figure 1;col.4,lines 8-31 - both Felts et al), for supporting a substrate (item 13, Figure 1,2)

lviii. and an RF power supply (item 17, Figure 1,2;col.3,line 61-65,Both Felts et al) ; a gas delivery system (item 15, Figure 1,2;col.3,lines 59--61) for delivering process gases (col.5,lines 3-40) into the process chamber (item 11, Figure 1;col.4,lines 8-31 - both Felts et al); a controller (item 27, Fig.1;col.5,line 27 through the end of the patent) configured to control the power supply (item 17, Figure 1,2;col.3,line 61-65,Both Felts et al) and the gas delivery system (item 15, Figure 1,2;col.3,lines 59--61)

lix. a memory (column 10, lines 56-64) coupled to the controller (item 27, Fig.1;col.5,line 27 through the end of the patent) comprising a computer readable program (column 16 - column

46- Felts et al 4,888,199) having a computer readable program (column 16 - column 46- Felts et al 4,888,199) embodied therein for directing operation of the substrate (item 13, Figure 1,2) processing system , the computer readable program (column 16 - column 46- Felts et al 4,888,199) including a first (column 5, lines 16-40) set of computer instructions (column 16 -column 46 - Felts et al- 199) for controlling the gas delivery system (item 15, Figure 1,2;col.3,lines 59--61) to flow He (col.5,lines 13-20, 42) into the process chamber (item 11, Figure 1;col.4,lines 8-31 - both Felts et al) at a selected flow rate to provide a chamber pressure in the range of 1-6Torr <u>(col.4,lines 10-11- Dory 4,877,641)</u>, a second (column 10, lines 47-50; col.31 - Felts et al 4,888,199) set of computer instructions (column 16 -column 46 - Felts et al- 199) for controlling the RF power supply (item 17, Figure 1,2;col.3,line 61-65,Both Felts et al) to supply power of 50-500 Watts (Thomas S. Dory - 4,877,641 - col.3, line 65 - col.4, line 11) to the process chamber (item 11, Figure 1;col.4,lines 8-31 - both Felts et al), a third set of computer instructions (column 16 -column 46 - Felts et al- 199)

lx. controlling a <u>heater (col.14,line 61-col.15,line 7)</u> to heat the substrate (item 13, Figure 1,2) to a temperature in the range of 200-400°C (column 3, lines 4-13-Thomas S. Dory 4,877,641), a fourth set of computer instructions (column 16 -column 46 - Felts et al- 199) for controlling the gas delivery system (item 15, Figure 1,2;col.3,lines 59--61)

lxi. and a fifth set of computer instructions (column 16 - column 46- Felts et al 4,888,199) to flow N_2O (col5,lines 37-42;col.1,line 21) at a flow rate of <u>5-300 sccm (col.3;lines31-33 - Dory 4,877,641)</u> into the process chamber (item 11, Figure 1;col.4,lines 8-31)

lxii. 54. (Amended) A substrate (item 13, Figure 1,2) processing system , comprising: a process chamber (item 11, Figure 1;col.4,lines 8-31 - both Felts et al); a substrate (item 13, Figure 1,2) support (item 53, Figure 2;col.4,lines 48-60), located within the process chamber (item 11, Figure 1;col.4,lines 8-31 - both Felts et al), for supporting a substrate (item 13, Figure 1,2)

lxiii. and a power supply (item 17, Figure 1,2;col.3,line 61-65,Both Felts et al) ; a gas delivery system (item 15, Figure 1,2;col.3,lines 59--61) for delivering process gases (col.5,lines 3-40) into the process chamber (item 11, Figure 1;col.4,lines 8-31 - both Felts et al); a controller (item 27, Fig.1;col.5,line 27 through the end of the patent) configured to control the power supply (item 17, Figure 1,2;col.3,line 61-65,Both Felts et al) and the gas delivery system (item 15, Figure 1,2;col.3,lines 59--61)

lxiv. a memory (column 10, lines 56-64) coupled to the controller (item 27, Fig.1;col.5,line 27 through the end of the patent) comprising a computer readable program (column 16 - column 46- Felts et al 4,888,199) having a computer readable program (column 16 - column 46- Felts et al 4,888,199) embodied therein for directing operation of the substrate (item 13, Figure 1,2) processing system, the computer readable program (column 16 - column 46- Felts et al 4,888,199) including a first (column 5, lines 16-40) set of computer instructions (column 16 - column 46- Felts et al 4,888,199) for controlling the gas delivery system (item 15, Figure 1,2;col.3,lines 59--61) to flow selected deposition gases (column 5, lines 17-40) into the process chamber (item 11, Figure 1;col.4,lines 8-31 - both Felts et al) at deposition gas flow

rates, a second (column 10, lines 47-50; col.31 - Felts et al 4,888,199) set of computer instructions (column 16 - column 46- Felts et al 4,888,199) for controlling the gas delivery system (item 15, Figure 1,2;col.3,lines 59--61) to add a flow of an inert gas (column 10, lines 47-50; col.31 - Felts et al 4,888,199) to the selected deposition gases (column 5, lines 17-40) at a flow rate previously determined to achieve a desired low deposition rate from a reaction of the selected deposition gases (column 5, lines 17-40), the desired low deposition rate being lower than a deposition rate using the selected deposition gases (column 5, lines 17-40) at the deposition gas flow rates with a lower flow rate of the inert gas (column 10, lines 47-50; col.31 - Felts et al 4,888,199), and a third set of computer instructions (column 16 - column 46- Felts et al 4,888,199) for controlling the power supply (item 17, Figure 1,2;col.3,line 61-65,Both Felts et al) to supply power to the process chamber (item 11, Figure 1;col.4,lines 8-31 - both Felts et al) to react the deposition gases (column 5, lines 17-40) to deposit a film at the low deposition rate.

lxv. 55. A substrate (item 13, Figure 1,2) processing system comprising:

lxvi. a process chamber (item 11, Figure 1;col.4,lines 8-31)

lxvii. a substrate (item 13, Figure 1,2) support (item 53, Figure 2;col.4,lines 48-60), located within the process chamber (item 11, Figure 1;col.4,lines 8-31 - both Felts et al), for supporting a substrate (item 13, Figure 1,2)

lxviii. a gas delivery system (item 15, Figure 1,2;col.3,lines 59--61) for delivering selected deposition gases (column 5, lines 17-40) into the process chamber (item 11, Figure

1;col.4,lines 8-31 - both Felts et al) at deposition gas flow rates; means for adding a flow of an inert gas (column 10, lines 47-50; col.31 - Felts et al 4,888,199) to the selected deposition gases (column 5, lines 17-40) at a flow rate previously determined to achieve a desired low deposition rate from plasma (column 5, lines 17-40) enhanced reaction of the selected deposition gases (column 5, lines 17-40), the desired low deposition rate being lower than a deposition rate using the selected deposition gases (column 5, lines 17-40) at the deposition gas flow rates with a lower flow rate of the inert gas (column 10, lines 47-50; col.31 - Felts et al 4,888,199); and means for depositing a thin film at the low deposition rate from a plasma (column 5, lines 17-40) enhanced reaction of the deposition gases (column 5, lines 17-40).

lxix. 56. The system of claim 55 further comprising: means for maintaining a chamber pressure of the process chamber (item 11, Figure 1;col.4,lines 8-31 - both Felts et al) in the range of 1-6Torr (col.4,lines 10-11- Dory 4,877,641); and means for heating the substrate (item 13, Figure 1,2) to a temperature in the range of 200-400°C (column 3, lines 4-13-Thomas S. Dory 4,877,641).

lxx. 57. A substrate (item 13, Figure 1,2) processing system comprising: a processing chamber (item 11, Figure 1;col.4,lines 8-31 - both Felts et al); a substrate (item 13, Figure 1,2) support (item 53, Figure 2;col.4,lines 48-60), located within the processing chamber , for supporting a substrate (item 13, Figure 1,2) ; means for flowing He (col.5,lines 13-20, 42) into the processing chamber at a selected flow rate to provide a chamber pressure in the range of 1-6Torr (col.4,lines 10-11- Dory 4,877,641); means for connecting the chamber to

an RF power supply (item 17, Figure 1,2;col.3,line 61-65,Both Felts et al) to receive 50-500 Watts (Thomas S. Dory - 4,877,641 - col.3, line 65 - col.4, line 11)

lxxi. and means for heating the substrate (item 13, Figure 1,2) to a temperature in the range of 200-400°C (column 3, lines 4-13-Thomas S. Dory 4,877,641); means for flowing SiH_4 through a gas distribution system at a flow rate of 5-300sccm means for flowing N_2O through the gas distribution system at a flow rate of 5-300 sccm (Thomas S. Dory; Col.3;lines 31-33), wherein a ratio of the selected flow rate of He (col.5,lines 13-20, 42) to the combined flow rate of SiH_4 and N_2O is at least 6.25:1 to deposit an antireflective layer on the substrate (item 13, Figure 1,2) at a deposition rate which is lower than a deposition rate using the same flow rate of SiH_4 and the same flow rate of N_2O with a lower flow rate of He (col.5,lines 13-20, 42) .

lxxii. 58. The system of claim 57 further comprising means for introducing NH_3 (col.4,lines 3-4; col.3,line 40 - Thomas S. Dory 4,877,641) into the chamber at a rate of 0-300 scan.

lxxiii. 59. The system of claim 58 further comprising means for introducing N_2 (col.3,lines 35-45;col.4,lines 5-6- Dory 4,877,641) into the chamber at a rate of 0-4000 sccm.

lxxiv. 62. A substrate (item 13, Figure 1,2) processing system comprising: means for flowing selected deposition gases (column 5, lines 17-40) into a substrate (item 13, Figure 1,2) processing chamber at deposition gas flow rates; means for adding a flow of an inert gas (column 10, lines 47-50; col.31 - Felts et al 4,888,199) to the selected deposition gases

(column 5, lines 17-40) at a flow to previously determined to achieve a desired low deposition rate from a reaction of the selected deposition gases (column 5, lines 17-40), said desired low deposition rate being lower than a deposition rate using said selected deposition gases (column 5, lines 17-40) at said deposition gas flow rates with a lower flow rate of said inert gas (column 10, lines 47-50; col.31 - Felts et al 4,888,199); and means for depositing a thin film at said low deposition rate from said reaction of said deposition gases (column 5, lines 17-40).

Felts et al (U.S.Pat. 5,364,665, and 4,888,199) do not teach, but Thomas S. Dory teaches:

lxxv. to flow SiH_4 at a flow rate of 5-300 sccm (col.3;line41) into the process chamber (item 11, Figure 1;col.4,lines 8-31 - both Felts et al),

lxxvi.

Felts et al (U.S.Pat. 5,364,665, and 4,888,199) and Thomas S. Dory do not teach:

wherein a ratio of the selected flow rate of He (col.5,lines 13-20, 42) to the combined flow rate of SiH_4 and N_2O is at least 6.25:1 to deposit an antireflective layer on the substrate (item 13, Figure 1,2) at a deposition rate which is lower than a deposition rate using the same flow rate of SiH_4 and the same flow rate of N_2O with a lower flow rate of He (col.5,lines 13-20, 42).

Felts et al (U.S.Pat. 4,888,199) anticipates the claimed relationship of deposition rates and the presence of an inert gas with added appreciation to the Felts et al (U.S.Pat. 4,888,199) dicussion:

Claimed:

$D_{-IG} > D_{+IG}$

Where D represents "deposition rate", "-/+" represents without (-) or with (+) inert gas (IG). With the addition of an IG (He) the partial pressures of all "selected deposition gases" will deminish and effectively "lower" or reduce the deposition rate. In addition, as discussed by Felts et al (U.S.Pat. 4,888,199), the addition of He increases electron density in the plasma (column 10, lines 47-50) which anticipates the effect of reduced deposition rates considering the fact that these added electrons would effectively shield cations thereby reducing one of the chemical mechanisms of PECVD - I

None of the above references teach the combined flow rate of SiH_4 and N_2O <u>is at least 6.25:1</u>.

However:

Thomas S. Dory:

200 - 4000sccm N_2O (col3.line 41)

Felts et al (U.S.Pat. 5,365,665):

500 - 1000sccm silane as alternative (col.5,lines40-41)

$$500/4000 = 1/8 \leq \frac{SiH_4}{N_2O} \leq 1000/200 = 5$$

It would have been obvious to one of ordinary skill in the art at the time the invention was made to increase the taught ratio taught by Felts et al (U.S.Pat. 5,365,665) to meet the the combined flow rate of SiH_4 and N_2O <u>of at least 6.25:1</u>.

Motivation for increasing the taught ratio taught by Felts et al (U.S.Pat. 5,365,665) to meet the combined flow rate of SiH_4 and N_2O of at least 6.25:1 is drawn from the Thomas S. Dory discussion - "control of film properties, as expressed by the refractive index (N_f)." (Col.3, lines 45-48), and "Thus for a given pressure and DTBS flow rate, increasing or decreasing the NH_3, N_2, N_2O, or NO flow rate changes the Nf of the film." (Column 3,lines 48-51).

In addition, the following outcomes may apply:

20.

CAUSE EFFECTIVE VARIABLES

It is well settled that determination of optimum values of cause effective variables such as these process parameters is within the skill of one practicing in the art. ***In re Boesch*, 205 USPQ 215 (CCPA 1980).**

CAUSE EFFECTIVE VARIABLES - Routine experimentation

It would have been obvious to one having ordinary skill in the art to have determined the optimum value of a cause effective variable such as [spray droplet size] through routine experimentation in the absence of a showing of criticality in the claimed size. ***In re Woodruff*, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).**

It would have been obvious to one having ordinary skill in the art to have determined the optimum values of the relevant process parameters through routine experimentation in the absence of a showing of criticality. ***In re Aller*, USPQ 233 (CCPA 1955).**

CRITICALITY OF PROCESSING PARAMETERS

If Applicant can establish a showing of criticality in the claimed pressure, the rejection will be withdrawn. See ***Ex parte Khusid*, 174 USPQ 59** ("Where the principal difference between the claimed process and that taught by the reference is a temperature difference, it is incumbent upon Applicant to establish criticality of that difference"). This decision is clearly analogous to pressure differences and other process parameters.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to select the preferred chamber controls of the (total) chamber pressure at about 1 to 6 torr (col.4,lines 10-11) as taught by Thomas S. Dory as the preferred preferred chamber controls of the Felts et al (U.S.Pat. 5,365,665) substrate processing system.

Motivation for selecting the preferred chamber controls of the (total) chamber pressure at about 1 to 6 torr (col.4,lines 10-11) as taught by Thomas S. Dory as the preferred preferred chamber controls of the Felts et al (U.S.Pat. 5,365,665) substrate processing system is drawn from the discussion of

Thomas S. Dory where "Thus this *control* of the relative flow rates of the reactants and the *pressure* permits precise *control* of the film properties." (Column 4, lines 27-29).

Conclusion

21. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Examiner Rudy Zervigon whose telephone number is (703) 305-1351. The examiner can normally be reached on a Monday through Thursday schedule from 8am through 7pm. The official after final fax phone number for the 1763 art unit is (703) 305-3599. Any Inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Chemical and Materials Engineering art unit receptionist at (703) 308-0661. If the examiner can not be reached please contact the examiner's supervisor, Gregory L. Mills, at (703) 308-1633.

JEFFRIE R. LUND
PRIMARY EXAMINER